Self-Rated Health: A Predictor of Mortality Among the Elderly

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Abstract: Data from the Manitoba Longitudinal Study on Aging (MLSA) were used to test the hypothesis that self-rated health (SRH) is a predictor of mortality independent of "objective health status" (OHS). Subjects were a random sample of non-institutionalized residents of Manitoba aged 65+ in 1971 (n = 3,128). A single item measure of SRH was obtained during a survey conducted in 1971; a baseline measure of OHS was derived from physician and self-reported conditions and health service utilization data. Occurrence and date of death during the years 1971–1977 were known.

Analyses of the data revealed that, controlling for OHS, age, sex, life satisfaction, income and urban/rural residence, the risk of early mortality (1971–1973) and late mortality (1974–1977) for persons whose SRH was poor was 2.92 and 2.77 times that of those whose SRH was excellent. This increased risk of death associated with poor self-rated health was greater than that associated with poor OHS, poor life satisfaction, low income and being male. These findings provide empirical support for the long held, but inadequately substantiated, belief that the way a person views his health is importantly related to subsequent health outcomes. (*Am J Public Health* 1982; 72:800–808.)

Introduction

Self-ratings of health, defined by responses to a single question such as "compared to others your own age, how do you rate your health?" are among the most frequently assessed health perceptions in epidemiological and gerontological research. Despite their widespread use and extensive research[1-7] directed toward identifying their determinants, there is no clear consensus concerning the meaning and, more importantly, the prospective significance of such ratings. Indeed, self-ratings of health are, in practice, frequently ignored or they are perceived as a convenient but somewhat questionable substitute for objective health status[4,8] or an indicator of general well-being.[9]

In the few studies that have sought to determine whether self-rated health has a unique effect on subsequent health and health-related behavior, a protective effect of positive health ratings has been observed suggesting that such ratings may have importance in their own right.

Garrity, for example, after controlling for clinical status, found self-rated health predicted level of morale and return to employment following a first myocardial infarction.[10,11] Likewise, Brown and Rawlinson found self-rated health positively associated with morale and the tendency to relinquish the sick role among persons who had experienced open heart surgery.[12] Self-rated health and physicians' health ratings were both reported to be significantly related to five-year survival among persons aged 77–84 but not among those over 85 years of age.[8] Moreover, in the follow-up of the midtown Manhattan sample, self-rated health, assessed in 1954, was found to be an important predictor of mortality in the ensuing 20 years.[9]

While the longitudinal studies cited above provide useful insights into the short- and long-term relationship of self-rated health to mortality, their limitations preclude drawing firm conclusions from their findings. Most of these studies used small and select samples. One, the midtown Manhattan study, involved a large representative sample but was unable to adequately control for the individual's objective health status because only self-reports of conditions and symptoms were available to the researchers. The importance of controlling for objective health status is well illustrated by the findings of another longitudinal study in which older volunteers were used and in which both physicians' and self-ratings of health were obtained.[13] The positive and statistically significant correlation between self-rated health and longevity disappeared when the analysis controlled for physicians' ratings of health. Clearly the influence of self-rated health on health-related events requires further investigation. For example, if self-assessed health is found to be a useful predictor of mortality, independent of objective health status, asking a relatively simple question would help to identify persons at risk irrespective of their clinical status. Based on this identification of a target population, interven-

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tion strategies could then be designed and tested with the objective of reducing the risk associated with having a poor perception of one's health.

The Manitoba Longitudinal Study on Aging (MLSA) overcomes many of the problems alluded to above and provides an opportunity to study the relationship between self-perceived health status and mortality in the elderly population. Based on a large, representative sample, data on self-rated health and objective health status (derived primarily from information provided by physicians) make it possible to examine the influence of self-rated health, independent of "objective health status," on subsequent mortality.

This paper: reports the results of analyses undertaken to assess the unique effect of self-rated health on mortality using the MLSA data; explores the clinical and epidemiological implications of these findings; and discusses the importance of further research into the meaning and effect of self-rated health on health and health-related events.

Materials and Methods

Details of the Manitoba Longitudinal Study on Aging have been reported elsewhere.[14,15] In brief, 3,533 subjects, stratified by region of residence, were selected at random from the non-institutional population aged 65+ in Manitoba, Canada. Information on sociodemographic, psychosocial, attitudinal, and health status characteristics was obtained from each person during a needs assessment interview conducted in mid-1971. Complete information on the health care utilization and mortality experience of each individual for the years 1970–1977 was obtained from the health care claims files and the master population registry maintained by the Manitoba Health Services Commission (MHSC) as part of the provincial universal health insurance program. The claims files contain data on the date, location, type, and reason for each physician and hospital service received by the individual. A longitudinal record linking survey responses, information on all physician and hospital services used during the study period, and date of death was constructed for each person.

The analyses here were based on the 3,128 persons for whom a complete record through December 1977 or date of death could be developed. This represented 88 per cent of the original survey sample. Exclusion occurred for 123 cases because an individual identification number common to both data sources was not available. For 151 cases the individual disappeared without documentation from the master population registry, the information source used to track the sample over the eight study years. For the remaining 131 excluded individuals, a proxy respondent was used during the interview and, thus, no attitudinal information, including an assessment of self-rated health, was obtained.

Comparison of the sample studied with the original survey sample revealed no statistically significant differences in terms of such sociodemographic characteristics as age, sex, marital status, ethnic background, or education. Furthermore, distributions among the study sample on these factors corresponded closely to those reported for the elderly population in Canada in 1971[16] and were remarkably similar to those for the White subset of elderly residents in the United States.[17] The only notable discrepancy was that males and females were equally represented in the study sample. While the reasons for this are not readily apparent, this reflects the sex distribution observed for the elderly Manitoba population.

Measurement of Variables

Self-rated health was defined by responses to the question, "For your age would you say, in general, your health is excellent, good, fair, poor or bad?" This was asked during the 1971 interview. While the reliability of individual ratings was not directly tested in this study, Ware, *et al*, concluded, after reviewing 39 studies of general health perceptions, that such ratings "appear both reliable and reproducible."[1]

Consonant with other studies,[3,5,7] cross-sectional analyses designed to assess the validity of the health ratings revealed the principal predictor of a person's self-rated health to be the number of health problems he/she reported; life satisfaction was the second most important predictor. Moreover, as noted by Filenbaum, females who rated their health as excellent or good were more likely to report more conditions than their male counterparts.[4]

Objective health status was defined as a function of the type and seriousness of conditions reported by a physician or the individual and the occurrence of health problems that resulted in hospitalization and/or surgery.

A composite index of objective health status was developed using information from the summary health care claims data for the year prior to the survey in mid-1971 and from the self-reports of conditions obtained during the survey. Details of this scale and the methods used in its construction are presented in the Appendix. Scores ranged from 0 (no reported health problems) to 23 (many reported and serious health problems). Analyses designed to assess the reliability and validity of the derived index indicated it to be both reliable and valid.

Mortality was assessed for two time periods: early mortality (1971–1973) and late mortality (1974–1977). Occurrence and date of death were ascertained by searching the MHSC master registry through 1978 and the hospital claims file through 1977. The master registry in Manitoba contains information on over 99 per cent of the provincial population. Occurrence of death is reported to the registry by means of a hospital discharge summary (for the approximate 70 per cent of older persons who die in hospital) and reports from death certificates provided by the provincial Department of Vital Statistics.

Age, sex, and other sociodemographic characteristics such as marital status, ethnic background, and monthly income were assessed during the 1971 survey. The life satisfaction index (LSI) developed by Neugarten, et al, was also administered at this time. This is a standard index with known reliability and validity in which life satisfaction is defined as a function of zest for life, resolution and fortitude, good self-concept and happy optimistic mood, etc.[18]

TABLE 1—Unadjusted Odds of Early (71–73) and Late (74–77) Mortality for Persons at Each Level of the Major Predictor Variables; Community Dwelling Elderly Sample: Manitoba Longitudinal Study on Aging

Characteristic	1971–1973 (n = 3128)				1974–1977 (n = 2857)‡			
	Alive	Dead	Odds of Death		Alive	Dead	Odds of Death	
Age in 1971								
60–69	984	43	.043	P < .001*	843	141	.167	P < .001
70–74	825	56	.068		682	141	.207	
75+	1050	172	.164		740	310	.419	
Sex								
Male	1415	164	.116	P < .001	1065	350	.329	P < .001
Female	1442	107	.074		1200	242	.202	
Location of Residence								
Winnipeg	1030	112	.109	NS	818	212	.259	NS
Other	1827	159	.087		1447	380	.263	
Objective Health								
Excellent	799	47	.059	P < .001	658	141	.214	P < .001
Good	867	61	.070		712	155	.218	
Fair	768	78	.102		601	167	.278	
Poor	423	85	.201		294	129	.439	
Self-Rated Health								
Excellent	410	23	.056	P < .001	354	56	.158	P < .001
Good	1414	100	.071		1153	261	.226	
Fair	780	102	.130		588	195	.331	
Poor	250	46	.184		170	80	.470	
Income								
Under $2000	1978	212	.107	P <.01	1558	420	.269	P < .05
$2000–4000	644	48	.074		506	138	.273	
$4000+	235	11	.047		201	34	.169	
Life Satisfaction**								
Excellent	693	52	.075	P < .001	579	114	.197	P < .001
Good	1214	91	.075		979	235	.240	
Fair	619	71	.115		460	159	.246	
Poor	260	40	.154		195	65	.333	

*Chi square values were calculated for differences in odds of death among categories.
**Information on life satisfaction was missing for 71 cases.
‡This includes the 2857 persons who survived to 1974.

Statistical Methods

Analysis of the data proceeded in two stages. Factors significantly related ($p < 0.05$) to both self-rated health and mortality that might confound the self-rated health/mortality association were first identified. While numerous sociodemographic and attitudinal factors such as marital status, ethnic background, years of education, and life satisfaction were examined, only age, sex, objective health status, annual income, and life satisfaction met this criterion. Although not significantly related to both self-rated health and mortality, residence, recoded as Winnipeg or other, was retained in these analyses because it provided adjustment for the different sampling fractions used in drawing the original survey sample (Winnipeg residents were sampled at a rate of 2.5 per cent; for all others, the rate was 5 per cent).

The data available for the second stage of analysis were in the form of a multifactorial contigency table. SRH was coded as excellent, good, fair, poor/bad; OHS was categorized into four levels: 0–3, excellent; 4–8, good; 9–13, fair; 14–23, poor. Scores on the LSI were coded as excellent (1–4), good (5–8), fair (9–12) and poor (13 and above). Three levels of annual income—under $2000, $2000–4000, and over $4000—were defined and individuals were grouped into three age categories: 65–69, 70–74, and 75+.

The relationships between SRH and early mortality, and late mortality, controlling for OHS and the other six factors in the model, were studied separately by use of the log linear[19,20] and multiple logistic risk models.[21] These models provide a means for assessing the relationship between a binary dependent variable and categorical predictor variables. When all variables are in a categorical format, as is the case here, they yield equivalent results.[22,23] Those from the multiple logistic regression are reported here. Specific methodological issues related to the analyses are described further in the Appendix.

Results

Eight hundred-seventy persons died between 1971 and 1977. Of these, 278 deaths (32 per cent) occurred during the early mortality period (1971–1973) and the remaining 592 between 1974 and 1977. Table 1 displays the distribution of the sample according to mortality status and the unadjusted

TABLE 2—Pearson Correlation Coefficients between Major Predictor Variables

	1	2	3	4	5	6	7
1. Self-Rated Health							
2. Objective Health Rating	.34**						
3. Age	.05*	.10*					
4. Sex	.05**	.08**	.01				
5. Residence Location	.08**	.03	.04	.04			
6. Life Satisfaction	.33**	.12**	.09**	.01	.00		
7. Income	.14**	.05**	−.14**	−.13**	−.13**		

*p value <0.05 and >0.01.
**p value <0.01.

odds of death for persons in each category of the variables included in the initial models tested. As expected, the odds of death were greater for males than females, higher among older persons, individuals with poor objective health status, and those with poor self-rated health; moreover, death was more likely among groups whose life satisfaction was diminished and whose income was low.

While examination of the unadjusted odds of death suggest all six factors to be associated with subsequent mortality, as shown in Table 2, self-rated health is also substantially related in the expected direction to these factors. For example, self-rated health declined with age and was positively associated with life satisfaction, income and objective health status. This latter association is shown more clearly in Table 3. For 33 per cent of the sample, self-rated health and objective health status are identical (those on the diagonal). When both self-rated health and objective health status are dichotomized into categories, excellent-good and fair-poor agreement on both measures is observed for 65 per cent of the sample. This corresponds closely to findings reported by Maddox[7] and Blazer and Houpt[6] who also compared dichotomous measures of self-rated and objective health status. It could be that self-rated health simply reflects objective health status and consequently has no unique importance for subsequent mortality.

The findings from the logistic regression, however, reveal a different picture. The final models for both early and late mortality are shown in Table 4. The two models are almost identical, the only difference being that residence location is significantly associated with early but not late mortality. Table 4 shows that, controlling for age, sex, objective health status and residence, the associations between self-rated health and early and late mortality are significant. Moreover, the absence of interaction terms that include mortality and self-rated health indicate the significance of self-rated health for mortality is the same whether one is in excellent or poor objective health, is male or female, old or young, or lives in Winnipeg or more rural Manitoba. When other factors are controlled, the associations between mortality and life satisfaction, and mortality and income are no longer significant.

The relative strength of the self-rated health/mortality association can be seen more clearly from inspection of the odds ratios shown in Table 5. As presented here, these odds ratios are simultaneously adjusted for all other variables in the model. With a relatively low incidence of mortality, the adjusted odds ratios are approximately equal to the relative risk. It can be seen from Table 5 that the odds (risk) of subsequent death, whether occurring early or late, are almost three times greater for those who rate their health as poor than for those who rate their health as good. The increased risk associated with diminished self-rated health is greater than that associated with sex or objective health status although the excess risk for these factors is in the expected direction. Only age appears to have a more powerful influence on mortality than self-rated health. The rela-

TABLE 3—Distribution of Study Sample by Self-Rated Health and Objective Health Status

	Objective Health Status									
	Excellent (0–3)		Good (4–8)		Fair (9–13)		Poor (14+)		TOTAL	
Self-Rated Health	n	%*	n	%	n	%	n	%	n	%
Excellent	175	5.6	164	5.2	77	2.5	17	0.5	433	(13.8%)
Good	508	16.2	461	14.7	388	12.4	157	5.0	1514	(48.4%)
Fair	143	4.6	228	7.3	293	9.4	221	7.1	885	(28.3%)
Poor	20	0.6	75	2.4	88	2.8	113	3.6	296	(9.5%)
TOTAL	846	27.0	928	29.6	846	27.0	508	16.2	3128	(100.0%)

*Per cent of total sample.

TABLE 4—Results of the Multiple Logistic Regression Analyses Showing the Terms in the Final Fitted Models

Early Mortality (1971–1973)			Late Mortality (1974–1977)		
Variable‡	B	SE	Variable‡	B	SE
SRH	.3568*	.0819	SRH	.3401*	.0608
OHS	.3125*	.0668	OHS	.1481*	.0484
SEX	−.5605*	.1339	SEX	−.5921*	.0969
AGE	.6702*	.0876	AGE	.4765*	.0584
LOC	−.3696*	.1341	LOC	−.1245	.0999

*$p < .01$.
‡Variable
SRH = self-rated health, 1971: excellent, good, fair, poor.
OHS = objective health status, 1971: excellent (0–3), good (4–8), fair (9–13), poor (14+).
SEX = male, female.
AGE = age category 1971: 65–79, 70–74, 75+.
LOC = location of residence 1971: Winnipeg, rest of Manitoba.

tively modest increased risk associated with advanced age, particularly for late mortality, may be due, in part, to the groupings of persons aged 75+ into one age category.

Recalling that self-rated health and objective health status both represent estimates made in 1971, it was expected that the associations with mortality would diminish over time. This is evident, particularly with respect to objective health status. Quite obviously, an individual's health status changes over time and a single measure is not capable of reflecting such change. The adjusted odds ratios associated with fair and poor self-rated health, however, are only moderately smaller for late mortality than for early mortality. This latter finding suggests that while objective health status may change over time, self-ratings of health represent a relatively stable perception held by the individual.

Discussion

Substantial evidence has been presented in support of the hypothesis that self-rated health has a relationship to mortality that is independent of the subject's level of objec-

TABLE 5—Adjusted Odds Ratios (AOR) for Early (71–73) and Late (74–77) Mortality and 95% Confidence Intervals Computed from the Logistic Coefficients (B) and Their Standard Errors

	Mortality 71–73			Mortality 74–77		
	AOR*	95%	C.I.**	AOR	95%	C.I.
Self-Rated Health		L	U		L	U
Excellent (reference level)	1	—	—	1	—	—
Good	1.42	1.22	1.67	1.41	1.24	1.58
Fair	2.04	1.48	2.81	1.97	1.21	3.21
Poor	2.92	1.80	4.72	2.77	1.92	3.90
Objective Health Status						
Excellent (reference level)	1	—	—	1	—	—
Good	1.37	1.20	1.55	1.16	1.06	1.26
Fair	1.87	1.44	2.43	1.34	1.12	1.60
Poor	2.55	1.68	3.87	1.56	1.19	2.03
Sex						
Males (reference level)	1	—	—	1	—	—
Females	0.57	0.44	0.74	0.55	0.45	0.67
Age						
65–69 (reference level)	1	—	—	1	—	—
70–74	1.95	1.65	2.31	1.61	1.44	1.79
75+	3.82	2.70	5.39	2.59	2.09	3.21
Residence Location						
Winnipeg (reference level)	1	—	—	1	—	—
Other	0.69	0.53	0.90	0.88	0.72	1.07

*Adjusted odds ratios were calculated as e^{DB} where B is the logistic coefficient corresponding to the predictor variable being considered. For the multi-level predictor variables, odds ratios for each level were computed by setting the odds of dying equal to one at the reference level. D then equals the deviation from the reference level.
**The 95% confidence intervals for the adjusted odds ratios were obtained from the formula $e^{(DB \pm DSE)}$ where SE is the standard error associated with the logistic coefficient B.

tive health status. Indeed, among those variables studied, self-rated health is second only to age in its strength as a predictor of early mortality and, in terms of late mortality, it emerges as the strongest predictor. Moreover, the importance of self-rated health is the same, irrespective of the person's objective health status, age, sex, and other sociodemographic factors; although measured at only one point, the predictive power of self-rated health appears stable over time.

The observed associations between self-rated health and mortality may result from the influence of unmeasured, confounding variables. However, this appears unlikely. During the initial stages of analysis, many factors suspected of or known to be associated with either self-rated health or mortality were considered. Those meeting the criteria for confounding (e.g., significantly associated with both self-rated health and mortality) were included in the initial analyses. However, it should be noted that certain physiological measures (e.g., blood pressure, serum cholesterol, and body weight), behavioral variables (e.g., exercise level, alcohol and cigarette consumption, and diet), and psychosocial factors (e.g., life changes and measures of emotional health) were not available for study. Moreover, while several measures of social connectedness, e.g., marital status and frequency of contact with friends and relatives, were included in the analysis, a composite social network index such as that developed by Berkman[24] was not constructed. It is possible that inclusion of these factors in the analysis would have modified the self-rated health mortality association. In previous research, however, where control for some of the above factors was possible, the significance of self-rated health for mortality was not affected. Specifically, in the 20-year follow-up of the mid-town Manhattan study, Singer, *et al*, report multivariate analyses showing a strong effect of self-rated health to be unchanged when measures of smoking behavior, alcohol consumption, obesity, mental health status, and self-reported hypertension were considered.[10]

Several interpretations of the meaning of the observed self-rated health/mortality associations appear plausible. First, self-rated health may reflect a prescient understanding of subtle biological and physiological changes that lead one to perceive one's own health either more positively or negatively but more correctly than objectively assessed health status. If this is the case, self-rated health contributes to the risk of mortality because it represents a finely tuned indicator of physiological well-being. Alternatively, maintenance of positive health habits (e.g., not smoking, moderate consumption of alcohol, and adequate exercise, nutrition, and rest) may lead one to have more positive self-ratings of health than expected from "objective assessments." The reduction in mortality risk associated with positive ratings might therefore be due to the combined effects of such habits rather than to self-rated health. It may also be that positive health ratings—even if discordant with objective ratings—are protective because positive, optimistic feelings, in themselves, are protective. Finally, once the effect of objective health status has been removed from the self-ratings of health, the residual may be entirely determined by the person's emotional health status. The observed risk of mortality for persons with poor self-ratings of health, therefore, may reflect the importance for mortality of depression or other emotional problems.

Information is not available to fully assess the adequacy of the above explanations. There is a need for further research to better understand how an individual actually arrives at a self-rating of health and why, in fact, such ratings are important predictors of mortality. Nonetheless, despite the present uncertainty regarding the dynamics of the self-rated health/mortality association, the findings reported here have clinical and epidemiological implications.

Specifically, the strength and apparent stability of the self-rated health/mortality association, the fact that for a substantial proportion of older persons self-ratings of health cannot be inferred directly from objective health ratings, and the ease with which such ratings can be obtained suggest that routine ascertainment of self-rated health during the course of medical care contacts is warranted. Individuals found to rate their health as fair or poor might appropriately be identified as "high risk" and followed with greater diligence and/or encouraged to adopt more positive attitudes, especially if they are unduly pessimistic about their health status. In this sample, 38 per cent of the elderly rated their health as fair or poor so that the benefits in terms of reduced risk of "premature" mortality could be substantial. Moreover, information on self-rated health would provide a means to detect persons for whom the risk of dying appears higher than indicated by their objective health status. As shown previously in Table 3, 466 persons (15 per cent of the sample) rated their health as fair or poor when it "objectively" appeared excellent or good. These "health pessimists" have a slightly greater risk of dying than their counterparts who were in objectively poor health but who were optimistic in their self-ratings.

A principal motivation for past research related to self-rated health appears to have been the desire to confirm the usefulness of such ratings as an indicator of objective health status.[4,8] This is important because a single measure of self-rated health is more easily and less expensively obtained than assessments made by a clinician. While the findings reported here do support the importance of assessing self-rated health, they suggest that, depending on the purposes of the research, such ratings should be combined with, rather than substituted for, objective health ratings. For about two-thirds of the older population, objective, and self-rated health measures appear closely related. When the research objective is to investigate the relationship between health status and other factors, however, whether to identify individuals at risk of subsequent health-related events or to explore causal relationships, reliance on self-rated health as an indicator of objective health status may be inappropriate, since approximately one-third of the subjects would be significantly misclassified.

This research has demonstrated that self-rated health, in its own right, is an important predictor of mortality. It has not, however, clarified either the reasons for this or the reasons why some persons view their health as excellent while others with ostensibly similar objective health status view their health as poor. Further research efforts are

needed to address these issues. Such research should be longitudinal in design and should include an "independent" measure of objective health status Moreover, while this study has focused on older persons, research directed toward individuals at all ages would be desirable.

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APPENDIX

I. *"Objective" health status index*

Two primary sources of information were available with which to develop an "objective" health status index. The claims data provided information on the number and type of diagnosis for each individual reported by a physician and the occurrence of health problems that resulted in hospitalization or surgery. The survey provided information on different conditions reported by the individual. Seven specific items of information derived from the claims data included:

1. The number of different ICDA-8 diagnoses reported;
2. The number of physician visits for conditions (diagnoses) defined as chronic;
3. The number of physician visits for conditions (diagnoses) defined as serious;
4. The number of physician visits for conditions (diagnoses) defined as increasing the individuals risk of not recovering from an illness;
5. The presence of a diagnosis for coronary heart disease, stroke, cancer, diabetes, or kidney disease;
6. The number of admissions to hospital;
7. The occurrence of surgery requiring hospitalization.

At each patient visit, the physician in Manitoba is required to indicate the primary health problem for which the visit occurred. This is entered into the health care claims

files as an ICDA-8 3-digit diagnostic code. ICDA diagnoses were classified according to: 1) the expected duration (chronic or acute); 2) the degree of seriousness; and 3) the associated risk to recovery. Diagnoses were defined as chronic if they represented a disease expected to last three or more months. Systems developed by the National Center for Health Statistics[25] and R. W. Andersen (University of Chicago Center for Health Administration Studies) for classifying diagnoses as chronic or acute were augmented by experienced geriatricians to develop an exhaustive system for each ICDA diagnostic code.

Seriousness of a diagnosis was defined as a function of the probability that a physician visit for the diagnosis was urgent. In the National Ambulatory Medical Care Survey (NAMCS),[26] physicians were asked to rate the seriousness of conditions seen during an office visit in terms of how urgently medical care for the condition was indicated. The distribution of the "seriousness" ratings associated with each ICDA diagnosis were used to develop a NAMCS code for the diagnosis. These range from 1 to 5, with 1 describing a diagnosis considered by physicians to be "not serious" for 75 per cent or more elderly persons visiting a doctor, to 5 for a diagnosis considered to be very serious for 75 per cent or more elderly persons.

The "Risk of Recovery" Index is based on the work of four research groups which sought to develop a classification system for long-term care patients.[27] A "risk to recovery" condition was defined as one that, if present, decreased the individual's chance of improvement or recovery and increased his/her chance of regression to death. Such conditions included, for example, alcoholism, anemia, diabetes mellitus, neurologic disorders. ICDA-8 diagnoses representing these conditions were assigned a code of 1; other diagnoses were coded 0.

The available data suggest that, as a source of information with which to differentiate individuals according to the presence of distinct conditions, the claims data may underreport conditions among low utilizers and overreport different ICDA diagnoses and, therefore, conditions among more frequent users.[28–31] To reduce the overestimation associated with frequent use, all claims based on items used in the scale were coded in such a manner that it was possible to achieve a maximum scale score with as few as three physician visits during the index year. For example, the number of visits for serious diagnoses, risk to recovery diagnoses, and chronic diagnoses were coded (0 = 0) (1, 2 = 2) (3+ = 3). To minimize underestimation due to infrequent use, the self-reports of 15 categories of conditions experienced in the year prior to the interview (e.g., coronary heart disease, stroke, diabetes, and stomach problems) were included in the objective health status scale. These were coded (0) no reported condition; (1) one reported condition; (2) two reported conditions; (3) three reported conditions; (4) four reported conditions; (5) five or more reported conditions. The final objective health status score was constructed by summing over individual scores on the eight items identified above. Scale scores ranged from 0–23.

Extensive assessments of the reliability and both predictive and construct validity of the scale were undertaken. The coefficient alpha, a measure of internal consistency that reflects the correlation between items making up a scale,[32] was 0.81. Moreover, the scale was observed to be significantly ($p < 0.05$) and appropriately associated with such measures of morbidity as the number of days spent in hospital during the index year, the number of activities of daily living for which the individual reported spending time sick in bed, and the occurrence of death in the year following the interview.

II. *Statistical Note*

Following the initial univariate analyses, a log-linear analysis of the data was performed. The log-linear model predicts the logarithm of the expected cell frequencies in a multifactorial contingency table using a linear combination of predictor variables. For these analyses, we tested the hypothesis that knowledge of a person's self-rated health did not add to our ability to predict the cell frequencies or, stated differently, that early (M71-73) and late (M74-77) mortality are independent of SRH.

Given a fairly complex multifactorial contingency table, as the case here, and the desire to focus on a specific hypothesis, several approaches to a log-linear model are available. All possible two-way and higher order interactions, including those between the predictor variables, may be included in an initial "saturated" model; each term is then systematically deleted until a parsimonious "best fitting" model is obtained. An alternative approach[22] is to "account for" the associations between the predictor variables by including an appropriate interaction term in each model tested. Since associations between the predictor variables were of no substantive significance to the hypothesis under study, the second approach was taken. The 7th order interaction term (SRH, OHS, LSI, INC, SEX, AGE) was the interaction chosen for inclusion in each model tested. The statistical significance of each term that represented an association with mortality was then tested by deleting it from the model and examining the change in the likelihood ratio chi square, the goodness of fit statistic used. Final models were developed separately for M71-73 and M74-77 that contained an interaction term as defined above and significant ($p < .05$) second order terms between mortality and the predictor variables; additional higher order interaction terms were not required to obtained a "best fitting" model.

Log-linear modeling as described above yields results that are equivalent to those obtained from logistic regression with categorical independent and dependent variables.[22,23] The log-linear coefficients can be used to derive expected cell frequencies, or, by doubling the coefficients involving a term that includes M71-73 or M74-77, the coefficients of the corresponding logit model can be obtained.[22] Either the expected cell frequencies or the derived logit coefficiencies can then be used to compute adjusted odds ratios such as those presented in Table 5. These odds ratios are those that pertain after simultaneously adjusting for all other predictor variables in the model.

The BMDP3F computer program used here for the log-linear analyses, however, did not yield standard errors of the log-linear parameters suitable for the calculation of confidence intervals around the adjusted odds ratios. To obtain these, multiple logistic regression was performed on the final two models identified from the log-linear analyses. Predictor variables were first entered into the logistic regression as categorical variables. A second analysis was undertaken in which SRH, OHS, and AGE were treated as ordinal. The results of these two analyses were not statistically different; for the final analyses, therefore, SRH, OHS, and AGE were treated as ordinal level.

Call for Abstracts
Epidemiology Exchange, APHA 110th Annual Meeting in Montreal

The Epidemiology Section will sponsor an Epidemiologic Exchange on Wednesday, November 17, 1982, at APHA's Annual Meeting in Montreal. The Exchange will provide a forum for presentation of investigations, studies, methods, etc., which have been conceived, conducted, and/or concluded so recently that abstracts could not meet the deadline for other Epidemiology Sessions. Papers submitted should deal with work conducted during the last 6–12 months.

Abstracts should be limited to 200 words; no special form is required. Abstracts should be submitted by October 1, 1982, to Robert A. Gunn, MD, Epidemiology Program Office, Bldg. 1, Room 5017, Centers for Disease Control, Atlanta, GA 30333.

UMWA Archives Open to Research

The West Virginia and Regional History Collection has announced that the United Mine Workers of America Health and Retirement Funds' archives have been deposited at the Collection and are now open to research. The archives, which comprise approximately 156 linear feet of records from the years 1946 to 1974, are for the first industry-wide pension and medical care plan in the United States. Included is correspondence of trustees John L. Lewis and Josephine Roche, records of the Miners' Memorial Hospital Association, and documents which relate to the *Blankenship v. Boyle* class action lawsuit.

For more information write the Curator, Regional History Collection, Colson Hall, West Virginia University, Morgantown, WV 26506.